

Brookhaven National Laboratory Sewage Treatment Plant

Facility Environmental Monitoring Report

Calendar Year 2001



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Prepared by:
D. Paquette, R. Lee, B. Hooda and M. Allocco
Environmental Services Division

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**Brookhaven National Laboratory
Sewage Treatment Plant
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***Summary of Results:** There were six reportable SPDES permit exceedances during CY 2001. Zinc concentrations in the STP discharge exceeded permit limits on five of the six occasions. Zinc was observed in sludge removed during the sewer-cleaning project, and its re-suspension during the cleaning operations was probably the most significant contributor to the permit excursions. The sixth permit excursion involved apparently elevated ammonia levels detected during the October 2001 SPDES monitoring. However, an internal control sample indicated a concentration below the permit limit. Therefore the Environmental Services Division classified this permit exceedance as questionable.*

Groundwater monitoring results indicate only minor impacts to groundwater quality from STP operations. In wells used to monitor the filter bed areas, metals (sodium and aluminum) were occasionally detected at concentrations that exceeded ambient water quality standards. Low levels of nitrates and tritium were also detected, but at concentrations below applicable water quality standards. No volatile organic compounds were detected in groundwater near the plant.

Environmental TLD measurements indicate that dose rates in the vicinity of the STP are equivalent to natural background values.

Background

The STP processes sanitary sewage for BNL facilities. The STP processed an average of 0.5 million gallons per day (MGD) during non-summer months and approximately 0.6 MGD during the summer months. Treatment of the sanitary waste stream includes: primary clarification to remove settleable solids and floatable materials; aerobic oxidation for secondary removal of the biological matter and nitrification of ammonia; secondary clarification; sand filtration for final effluent polishing; and, ultraviolet disinfection for bacterial control prior to discharge into the Peconic River. By regulating the oxygen levels during the treatment process, nitrogen can be biologically removed by using nitrate bound oxygen for respiration. This discharge is regulated under a NYSDEC SPDES permit (NY-0005835).

Wastewater from the STP's clarifier is released to the sand filter beds, where the water percolates through three feet of sand before being recovered by an underlying clay tile drain system, which transports the water to the discharge point at the Peconic River

(SPDES Outfall 001). Approximately 15% of the water released to the filter beds is either lost to evaporation or to direct groundwater recharge. At the present time, six sand filter beds are used in rotation.

Two emergency hold-up ponds are located to the east of the sand filter bed area. The hold-up ponds are used for the emergency storage of sanitary waste in the event of an upset condition or if the influent contains contaminants in concentrations exceeding BNL administrative limits and/or SPDES permit effluent release criteria. The hold-up ponds are equipped with fabric reinforced (hypalon) plastic liners that are heat-welded along all seams. The first lined hold-up pond was constructed in 1978, and has a capacity of approximately four million gallons. A second four million gallon capacity lined pond was constructed in 1989, for a combined capacity of nearly eight million gallons. The combined capacity of the hold-up ponds provides the Laboratory with the ability to divert all sanitary system effluent for approximately twelve days. As part of Phase III Sewage Treatment Plant Upgrades project in 2001, the original single liners were replaced with double liners and an integrated leak detection system.

Environmental Monitoring Program

BNL has established an environmental monitoring program at STP to evaluate potential impacts to environmental quality and to demonstrate compliance with DOE requirements and applicable federal, state and local laws, regulations and permits. The primary monitoring program is conducted in accordance with BNL's SPDES permit. BNL also uses groundwater monitoring to provide a secondary means of evaluating potential impacts of STP operations. The environmental monitoring program for the STP is described in the BNL Environmental Monitoring Plan (Daum *et al.* 2000; BNL, 2001). The monitoring programs specifically designed for the STP area are summarized below.

Monitoring Results

SPDES Monitoring

Sanitary and process wastewaters generated by Laboratory operations are conveyed to the STP for treatment prior to discharge to the Peconic River. The STP provides tertiary treatment of sanitary and process wastewater (i.e., biological reduction of organic matter and reduction of nitrogen). This treatment process became fully functional in 1998.

The locations of SPDES monitoring points are presented on Figure 1. A summary of the CY 2001 monitoring results for the STP discharge at Outfall 001 is provided in Table 1.

While the STP discharge complies with SPDES permit limits more than 95% of the time, periodic excursions are noted annually. During 2001 there were six reported exceedances. Zinc concentrations in the STP discharge accounted for five of the six permit excursions during CY2001. The Environmental Services Division completed a

liquid effluent assessment following the zinc excursions to ensure all wastewater was being handled properly at the source. This assessment did not identify any possible sources of zinc. Hazardous waste characterization of sludges removed during the Plant Engineering sewer-cleaning project found zinc to be very mobile at concentrations above 3 mg/L (SPDES limit 0.1 mg/L). Therefore, the sewer cleaning is thought to be the most probable cause of the SPDES permit violations. It is recommended that all future sewer-cleaning activities should include collection and characterization of wastewater before release to the STP.

The sixth permit excursion involved the ammonia concentration during October SPDES monitoring. The results received from the New York State certified analytical laboratory exceeded the permit limit whereas, BNL process control tests of the same water sample was below the limit. Since routine monitoring of the Sewage Treatment effluent shows ammonia concentrations to be significantly below the permit limit, the permit exceedance is questionable.

Radiological Monitoring

The STP effluent is sampled at the output of the primary clarifier (Station DA) and at the Peconic River Outfall (Station EA). At each location, samples are collected daily on a flow-proportional basis; that is, for every thousand gallons (3,780 L) of water treated, approximately 4 fluid ounces (125 ml) of sample are collected and composited into a 5-gallon (18.9-L) collection container. These samples are analyzed for gross alpha and gross beta activity and tritium concentrations. Samples collected from these locations are also analyzed for gamma-emitting radionuclides and strontium-90 on a monthly basis. The frequency of radiological monitoring was reduced to three times per week in November of 2001 due to the reduced source term of radionuclides with the shutdown of the HFBR and the BMRR.

The Safe Drinking Water Act (SDWA) specifies that no individual may receive an annual dose greater than 4 mrem (40 μ Sv) per year from radionuclides present in drinking water. Although the Peconic River is not used as a direct source of potable water, BNL applies the stringent drinking water standards for comparison purposes, in lieu of DOE wastewater criteria. Under the SDWA, the annual average gross alpha activity limit is 15 pCi/L (0.6 Bq/L) (including radium-226, but excluding radon and uranium). The SDWA also stipulates a 50 pCi/L (1.85 Bq/L) gross beta activity screening level, above which radionuclide-specific analysis is required. BNL goes beyond this basic screening requirement by performing radionuclide-specific gamma analysis regardless of the gross beta activity. Other SDWA-specified drinking water limits are 20,000 pCi/L (740 Bq/L) for tritium and 8 pCi/L (0.3 Bq/L) for strontium-90. For all other radionuclides, Derived Concentration Guides (DCGs) found in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, (DOE, 1993) are used as reference values to maintain radionuclide concentrations well below the 4% of the DCG value for ingestion, which, if continuously ingested over a calendar year, would produce an effective dose equivalent of 4 mrem (4×10^{-5} Sv).

Gross activity (alpha and beta) measurements were used as a screening tool for detecting the presence of radioactivity. Annual average gross alpha and beta activity in the STP effluent has remained consistent with levels at control locations offsite on the Peconic and Carmans Rivers for many years. This continued to be the case in during the CY 2001. The average gross alpha and beta activity at the STP Outfall 001 was 1.6 pCi/L (0.04 Bq/L) and 7.2 pCi/L (0.3 Bq/L), respectively during this time. Figures 2 and 3 provide the gross alpha and gross beta concentration trends in the STP effluent to the Peconic River for 2001.

Tritium detected at the STP originates from either High Flux Beam Reactor (HFBR) sanitary system releases, or small, infrequent batch releases from other BNL facilities that meet BNL discharge criteria. Tritium continues to be released from the HFBR at very low concentrations due to evaporative losses of primary coolant and condensation within the air conditioning units. Figure 4 provides the tritium concentration trend in the STP effluent to the Peconic River for 2001.

For CY2001 the average tritium concentration as measured at the STP outfall (EA, Outfall 001) was 138 pCi/L. This value is below the average Minimum Detection Limit (MDL) of 329 pCi/L. The maximum concentration of tritium was 940 pCi/L. A total source term of 0.073 Ci of tritium was released during the year. As seen in Figure 5, this is a small release compared with operational years of the HFBR. Reduced concentrations of tritium are primarily the result of operations readying the HFBR for permanent closure. In 2000 most of the primary coolant, that has very high concentrations of tritium, was drained from the Reactor and shipped offsite. The Reactor was subsequently refilled with tap water. This significantly reduced the inventory of tritium at the HFBR. These levels will continue to decline as the HFBR moves into permanent decommissioning.

Gamma spectroscopy analysis of the monthly STP composite samples for radionuclides detected Cs-137 once during CY 2001 at both Stations DA and EA with concentrations of 1.72 +/- 1.41 pCi/L and 1.22 +/- 0.69 pCi/L respectively. Analysis of the monthly composite samples for Sr-90 detected the isotope once at Station DA and twice at Station EA. The highest concentration of 0.3 pCi/L was detected at Station EA, the STP effluent to the Peconic River, in January. This result is 0.04% of the SDWA limit of 8 pCi/L.

Groundwater

The STP's groundwater monitoring program is designed to provide a secondary means of verifying that STP operations are not impacting environmental quality. Six wells are used to monitor groundwater quality in the filter bed area and three wells are monitored in the holding pond area (Figure 6). Groundwater monitoring results for CY 2001 indicate only minor impacts to groundwater quality from STP operations.

Radiological Analyses: Radioactivity levels in samples collected from the STP wells were generally typical of ambient (background) levels (Table 2). Tritium was only detected in one well located in the immediate filter bed area, where one sample from Well 039-08 had a tritium concentration of 392 pCi/L. The drinking water standard for tritium is 20,000 pCi/L. Slightly higher levels of tritium (up to 1,420 pCi/L) were detected in Well 039-89 located downgradient of the holding ponds. Because the ponds have not been used recently to hold tritiated wastewater and the wells are also located downgradient of the filter bed area, it is likely that the tritium originated from past water releases to the filter beds. An elevated gross alpha concentration of 23.8 pCi/L was detected in the June sample from Well 039-86. This value exceeds the 15 pCi/L standard. In response to this result, the well was resampled in July. Analysis of the July sample indicated a gross alpha value of less than the minimum detectable level of 0.7 pCi/L. It is likely that the elevated gross alpha concentration in the June sample is due to an erroneous measurement or sample cross contamination. If the groundwater sample had confirmed the elevated gross alpha result, BNL would have to conduct radionuclide-specific analyses to identify possible alpha emitting radionuclides.

Non-radiological Analyses: During CY 2001, all water quality and most metals concentrations were below the applicable New York State Ambient Water Quality (NYS AWQS) (see Tables 3 and 4). Sodium was detected at concentrations slightly above the NYS AWQS of 20 mg/L in three filter bed area wells. Wells 039-07, 039-08 and 039-86 had maximum sodium concentrations of 28.5 mg/L, 29.3 mg/L and 30.5 mg/L, respectively. One sample from well 039-87 had an aluminum concentration slightly above the 0.1 mg/L standard. Nitrates were detected in most STP area wells, with a maximum concentration of 6.5 mg/L detected in filter bed area monitoring Well 039-08. The NYS AWQS for nitrate is 10 mg/L. No volatile organic compounds were detected in any of the monitoring wells.

Environmental TLDs

Measurements of environmental background radiation are conducted through a network of onsite and offsite environmental TLDs. The TLDs allow for the measurement of radiation from cosmic and terrestrial sources, as well as any contribution from Laboratory operations. One TLD (ID# 038-450) is located at the STP. TLD data are collected from this monitoring location on a quarterly basis. The ambient dose rates for the four quarters of 2001 were 17.6, 15.6, 16.3, and 18.2 mrem, respectively. The dose rates were similar to normal background rates found in the area.

Future Monitoring Actions

It is recommended that:

- SPDES monitoring program will continue per permit requirements.
- Maintain the groundwater monitoring program on its current semiannual schedule.
- Continue the TLD monitoring program on its current schedule.

References

BNL, 2001. Brookhaven National Laboratory Environmental Monitoring Plan, CY 2001 Update (January 2001). BNL-52584 Update.

Daum, M., Dorsch, W., Fry, J., Green, T., Lee, R., Naidu, J., Paquette, D., Scarpitta, S., and Schroeder, G., 2000. Brookhaven National Laboratory, Environmental Monitoring Plan 2000 (March 31, 2000).

DOE Order 5400.5. 1990. *Radiation Protection of the Public and the Environment*. U.S. Department of Energy, Washington, D.C. Change 2: 1-7-93.

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SPDES Monitoring Program
Table 1

Analyte	Min.	Max.	Min. Monitoring Frequency	SPDES Limit	No. of Exceedances	Percent Compliance*
Max. Temperature (°F)	46	81	Daily	90	0	100
pH (SU) ⁽¹⁾	5.8	7.2	Cont. Recorder	Min. 5.8	0	100
				Max. 9.0		
Avg. 5 day Biological Oxygen Demand (BOD) (mg/L)	1	7	Twice Monthly	Avg. 10	0	100
Max. 5 day BOD (mg/L)	< 2	17	Twice Monthly	Max. 20	0	100
% BOD Removal	> 86	>97	Monthly	85	0	100
Avg. Total Suspended Solids (TSS) (mg/L)	< 4	4.5	Twice Monthly	Avg. 10	0	100
Max. TSS (mg/L)	< 4	5	Twice Monthly	Max. 20	0	100
% TSS Removal	> 89	100	Monthly	85	0	100
Settleable Solids (ml/L)	0.0	0.0	Daily	0.1	0	100
Ammonia Nitrogen (mg/L)	< 0.1	2.9	Twice Monthly	2	1(a)	96

Total Nitrogen (mg/L)	5.4	10	Twice Monthly	10	0	100
Total Phosphorus (mg/L)	0.9	1.8	Twice Monthly	NA	0	100
Cyanide (µg/L)	< 10	< 10	Twice Monthly	100	0	100
Copper (mg/L)	0.03	0.07	Twice Monthly	0.15	0	100
Iron (mg/L)	0.15	0.30	Twice Monthly	0.37	0	100
Lead (mg/L)	< 0.001	0.009	Twice Monthly	0.019	0	100
Nickel (mg/L)	0.003	0.006	Twice Monthly	0.11	0	100
Silver (mg/L)	<0.001	0.003	Twice Monthly	0.015	0	100
Zinc (mg/L)	0.02	0.21	Twice Monthly	0.1	5 ^(b)	82
Mercury (mg/L)	< 0.0001	0.0002	Twice Monthly	0.0008	0	100
Toluene (µg/L)	< 1	< 1	Twice Monthly	5	0	100
Methylene Chloride (µg/L)	< 1	2	Twice Monthly	5	0	100
1,1,1-Trichloroethane (µg/L)	< 1	< 1	Twice Monthly	5	0	100
2-Butanone (µg/L)	< 1	< 5	Twice Monthly	50	0	100

PCBs (µg/L)	< 0.065	< 0.065	Quarterly	NA ⁽²⁾	0	100
Max. Flow (MGD)	0.5	0.7	Cont. Recorder	Max. 2.3	0	100
Avg. Flow (MGD)	0.4	0.6	Cont. Recorder	NA ⁽²⁾	0	100
Avg. Fecal Coliform (MPN/100	< 2	90	Twice Monthly	200	0	100
Max Fecal Coliform (MPN/100 ml) ⁽⁴⁾	< 2	130	Twice Monthly	400	0	100

* % Compliance = [(Total No. Samples – Total No. Exceedances) / Total No. of Samples] x 100

MGD=Million Gallons per Day

MPN=Most Probable Number

NA = Not Applicable

SU = Standard Unit

- (a) There were permit exceedances in January, February, and March of 2001. The violations are probably due to sewer upgrades being performed onsite during this time.
- (b) A permit exceedance occurred in October of 2001. The results received from the New York State certified analytical laboratory exceeded the permit limit whereas, BNL process control tests of the same water sample was below the limit. Since routine monitoring of the Sewage treatment Plant effluent shows ammonia concentrations to be significantly below the permit limit of 2.0 mg/L, the permit exceedance data is questionable

BNL Facility Environmental Monitoring Report
Sewage Treatment Plant
Groundwater Monitoring Program
Gross Alpha, Gross Beta, Tritium and Gamma Spectroscopy Results for CY 2001
Table 2

Well	Sample Period	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Tritium (pCi/L)	Gamma Spectroscopy Results
038-02 a	June December	1.3 +/- 0.7 <0.9	5.4 +/- 1.5 3.4 +/- 1.4	<346 <370	Only naturally occurring radionuclides detected
038-03 a	June December	<1.0 <0.8	9.0 +/- 1.6 5.7 +/- 1.5	<292 <314	Only naturally occurring radionuclides detected
039-07 a	June December	5.5 +/- 1.0 <0.9	4.7 +/- 1.5 6.9 +/- 1.5	<346 <370	Only naturally occurring radionuclides detected
039-08 a	June December	<1.0 <0.8	2.2 +/- 1.4 3.4 +/- 1.4	392 +/- 198 <314	Only naturally occurring radionuclides detected
039-86 a	June December	23.8 +/- 1.8 (c) <0.9	18.3 +/- 1.6 5.4 +/- 1.4	<346 <370	Only naturally occurring radionuclides detected
039-87 a	June December	<1.0 <0.8	5.8 +/- 1.5 5.4 +/- 1.4	<292 <314	Only naturally occurring radionuclides detected
039-88 b	June December	<1.0 <0.8	1.5 +/- 1.4 3.7 +/- 1.4	<292 <314	Only naturally occurring radionuclides detected
039-89 b	June December	<1.0 <0.8	8.2 +/- 1.6 7.0 +/- 1.5	1,420 +/- 239 1,330 +/- 236	Only naturally occurring radionuclides detected
039-90 b	June December	<1.0 0.9 +/- 0.5	3.8 +/- 1.5 38.4 +/- 2.3 (d)	<292 <314	Only naturally occurring radionuclides detected
Typical MDL		1.1	2.2	300	--
NYS AWQS		15	1,000	20,000	--

a: Well is located near STP Filter Beds.

b: Well is located immediately downgradient of STP Holding Ponds. Well is also nominally downgradient of the STP filter bed area.

c: Accuracy of the gross alpha/beta results for this sample is suspect. New sample collected July 10, 2001 had a gross alpha reading of <0.7 pCi/L and gross beta of 3.7 pCi/L.

d: Accuracy of the gross beta result for this sample is suspect. New sample collected January 22, 2002 had a gross beta reading of 4.8 pCi/L.

MDL = Minimum Detection Limit.

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Water Quality Results for CY 2001
Table 3

Well	Sample Period	Chlorides (mg/L)	Sulfates (mg/L)	Nitrate (mg/L)
038-02a	June	7.8	9.4	3.1
	December	<4.0	9.5	4.4
038-03a	June	5.7	13.8	1.2
	December	<4.0	21.3	1.0
039-07a	June	6.1	9.3	1.7
	December	43.5	10.7	6.0
039-08a	June	32.5	9.7	6.4
	December	34.8	16.4	6.5
039-86a	June	15.7	13.7	5.3
	December	37.8	15.0	6.3
039-87a	June	6.1	15.1	2.3
	December	5.2	13.2	1.5
039-88b	June	4.4	14.2	2.6
	December	4.9	15.4	3.3
039-89b	June	4.5	9.4	1.7
	December	<4.0	10.5	2.5
039-90b	June	5.9	11.1	1.1
	December	10.6	9.5	2.2
Typical MDL		4.0	4.0	1.0
NYSAWQS		250	250	10

MDL: Minimum Detection Limit

a: Well is located near STP Filter Beds.

b: Well is located immediately downgradient of STP Holding Ponds. Well is also nominally downgradient of the STP filter bed area.

**BNL Facility Environmental Report
Sewage Treatment Plant
Groundwater Monitoring Program
Metals Analytical Results for CY 2001
Table 4**

Well	Sample Period	Ag (mg/L)	Al (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Na (mg/L)	Pb (mg/L)	Zn (mg/L)
038-02 a	June	<0.001	0.008	<0.001	<0.001	0.004	<0.075	<0.0001	0.003	6.9	<0.001	0.013
	December	<0.001	0.032	<0.001	<0.001	0.005	<0.080	<0.0001	<0.002	6.5	<0.001	<0.004
038-03 a	June	<0.001	0.089J	0.001	<0.001	0.007	<0.075	<0.0001	0.017	3.4	<0.001	0.214
	December	<0.001	0.006	<0.001	<0.001	0.003	<0.080	<0.0001	0.146	2.3	<0.001	0.035
039-07 a	June	<0.001	0.005J	<0.001	<0.001	0.013	<0.075	<0.0001	0.002	6.1	<0.001	0.011
	December	<0.001	0.016	<0.001	<0.001	0.006	<0.080	<0.0001	0.009	28.5	<0.001	0.012
039-08 a	June	<0.001	0.012J	<0.001	<0.001	0.012	<0.075	<0.0001	<0.002	25.3	<0.001	<0.004
	December	<0.001	0.011	<0.001	<0.001	0.013	<0.080	<0.0001	<0.002	29.3	<0.001	<0.004
039-86 a	June	<0.001	0.021	<0.001	<0.001	0.006	<0.075	<0.0001	0.097	21.7	<0.001	<0.004
	December	<0.001	0.033	<0.001	<0.001	0.011	<0.080	<0.0001	0.129	30.5	<0.001	<0.004
039-87 a	June	<0.001	0.110	0.001	<0.001	0.004	<0.075	<0.0001	0.027	3.8	<0.001	0.148
	December	<0.001	0.058	<0.001	<0.001	<0.002	<0.080	<0.0001	0.029	5.0	<0.001	0.018
039-88 b	June	<0.001	0.022J	<0.001	<0.001	0.003	<0.075	<0.0001	0.008	3.2	<0.001	<0.004
	December	<0.001	0.013	<0.001	<0.001	<0.002	<0.080	<0.0001	0.008	7.2	<0.001	<0.004
039-89 b	June	<0.001	0.041	<0.001	<0.001	0.002	<0.075	<0.0001	0.018	3.0	<0.001	0.013
	December	<0.001	0.062	<0.001	<0.001	<0.002	<0.080	<0.0001	0.029	3.9	<0.001	<0.004
039-90 b	June	<0.001	0.010	<0.001	<0.001	0.006	<0.075	<0.0001	0.002	4.1	<0.001	<0.004
	December	<0.001	0.004	<0.001	<0.001	0.003	<0.080	<0.0001	0.003	7.2	<0.001	<0.004
Typical MDL		0.001	0.002	0.001	0.001	0.002	0.075	0.0001	0.002	1.0	0.001	0.004
NYSAWQS		0.05	0.1	0.01	0.05	0.2	0.3	0.0007	0.3	20	0.025	0.3

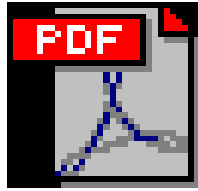
Note: Primary potential contaminants shown. Other metals were analyzed for – see database for complete data set

MDL: Minimum Detection Limit

NA: Not analyzed for.

a: Well is located near STP Filter Beds.

b: Well is located downgradient of STP Holding Ponds.



schematic of stp.pdf

Figure 1: Schematic of the Sewage Treatment Plant

Figure 2 - STP Outfall Gross Alpha Trend, CY 2001

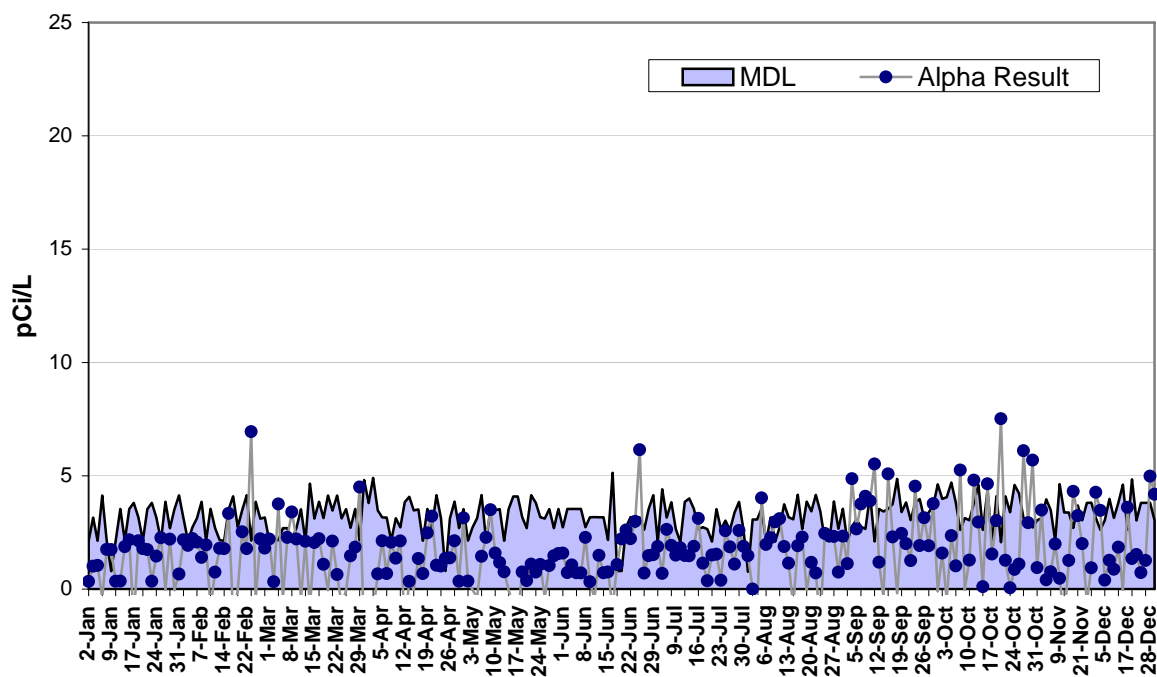


Figure 3 - STP Outfall Gross Beta Trend, CY 2001

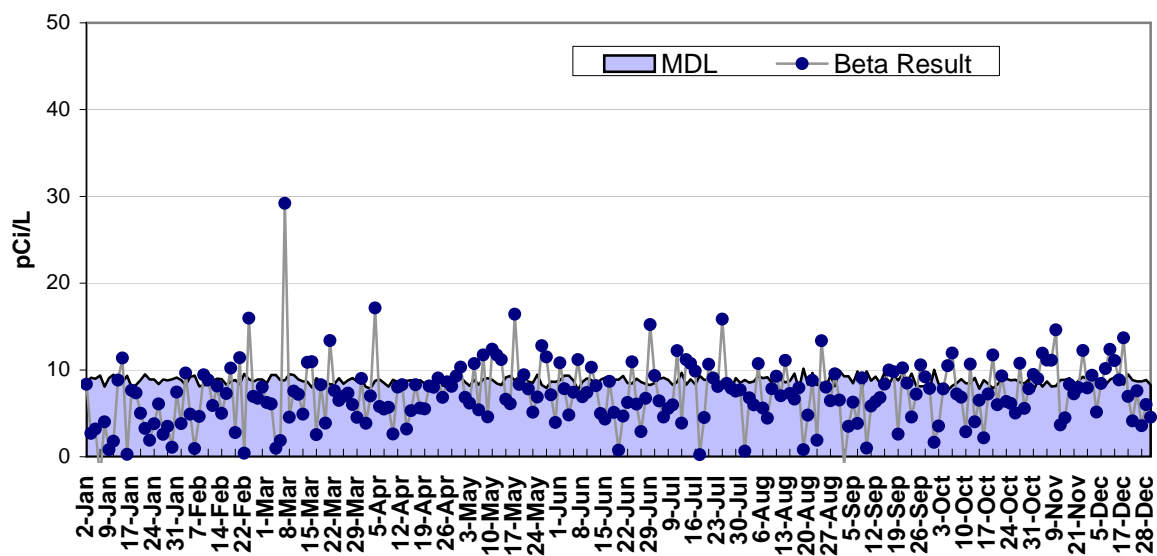


Figure 4 - STP Outfall Tritium Trend, CY 2001

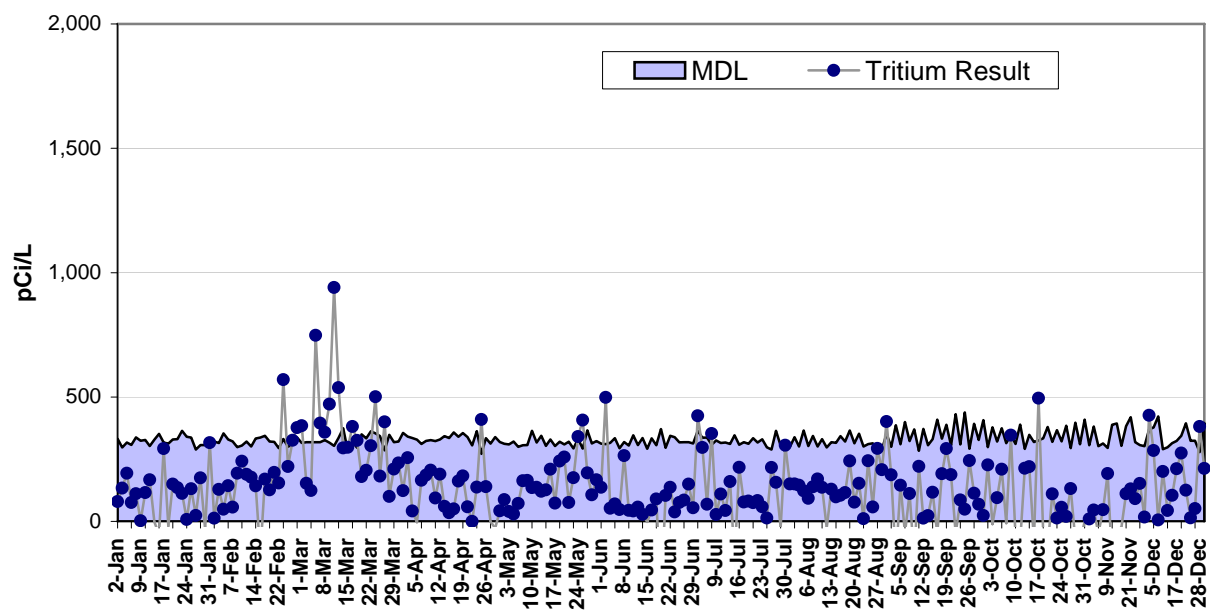


Figure 5- Tritium Released to the Peconic River, 15 Year Trend (1987-2001)

